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THE ECONOMIC VULNERABILITY INDEX: SOME CONCEPTUAL AND METHODOLOGICAL ISSUES

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1. INTRODUCTION

It is increasingly being realised that policy and decision-making require indices to succinctly summarise tendencies and trends in the variables under consideration. The advantages associated with such indices are numerous, but the most important advantage would seem to be that these can be used to represent complex phenomena in a format which permits easy comparison over time, or across subjects.

The vulnerability indices discussed in this paper deal with economic, social or environmental phenomena, which are multifaceted, and have various dimensions. There is therefore the temptation to complicate matters by having a high degree of detail, which could render the index non-operational. An important point made in this paper is that simplicity should always be kept in mind when computing indices, given that at the end of the day the purpose of constructing an index is to use it and not just to discuss it.

An important point to be stressed at this early stage is that vulnerability is not the same thing as poverty or economic backwardness. In other papers, the present author referred to what he called the "Singapore Paradox" (Briguglio, 2002). There are a number of Small Island Developing States (SIDS) - Singapore, Cyprus and Malta are prime examples – that are very economically vulnerable, but have managed to generate high income per capita in spite of this condition. The reason for this is that it is possible for SIDS to build up their own resilience to improve their ability to cope with vulnerability.

Indices of economic backwardness should be clearly distinguished from those purporting to measure vulnerability. The former are generally based on income per capita, sometimes augmented by social or quality-of-life variables, such as education and health, or by economic-structure variables, such as the relative size of the agricultural sector. In this paper, it will be argued, however, that economic backwardness may be associated with limited resilience and/or limited ability to cope with and to manage vulnerability.

This paper also proposes more focused definitions of vulnerability and resilience, defining the former in terms of inherent conditions and the latter in terms of policy designed to cope with or adapt to vulnerability.

This rest of the paper is organized as follows. Section 2 discusses the meaning of vulnerability and explains why SIDS are assumed to be particularly vulnerable. Section 3 reviews the main vulnerability indices developed so far with regard to economic, environmental and social considerations. Section 4

discusses a number of methodological problems, while section 5 deals with the strengths and weaknesses associated with indices. Section 6 concludes the paper.

2. VULNERABILITY AND SMALL ISLAND DEVELOPING STATES

The term vulnerability may be defined as "proneness to harm or damage originating from external forces", although the definition is often couched in a more difficult language. This condition is often associated with SIDS because these tend to be inherently very exposed to factors outside their control.

2.1 Why Small Island States deserve Special Attention

The Programme of Action for Small Island Developing States, adopted during a United Nations conference held in Barbados in 1994 (United Nations, 1994) emphasized the special and, in many respects, unique situation of SIDS, in terms of their vulnerability, and noted that special policy approaches were required to effectively address and resolve the sustainable development problems of those States.

2.2. Economic Vulnerability

The economic characteristics of SIDS are well documented (see for example Briguglio, 1995; Commonwealth Secretariat, 1985; 2000). These include the small domestic market, limited ability to exploit economies of scale; lack of natural resource endowments and high import content (especially of strategic imports such as food and fuel); limitations of diversification possibilities and market thinness; limitations on the extent to which domestic competition policy can be applied; dependence on a narrow range of export products; inability to influence international prices; and uncertainties of supply due to remoteness and insularity.

Small size also creates problems associated with public administration, the most important of which is probably the small manpower resource base from which to draw experienced and efficient administrators. Another problem is that many government functions tend to be very expensive per capita when the population is small, due to the fact that certain expenses are not divisible in proportion to the number of users.

The economic vulnerability of SIDS arises from the fact that their economies are, to a large extent, shaped by forces outside their control, mostly due to their economic openness and high dependence on a narrow range of exported products (see Briguglio, 1985).

2.3. Environmental Vulnerability of SIDS

Environmental problems are likely to be particularly intense in SIDS due to a number of factors, some due to natural forces, others brought about as a result of economic development.

The pressure on the environment arising from the process of economic development in SIDS tends to be much higher than in other countries. In many islands, increased demand for residential housing, tourism structures and industrial buildings has given rise to a fast depletion of undeveloped land. This is especially so for those SIDS that experience intense use of the coastal zone for tourism and marine related activities.

SIDS also tend to face severe waste management problems. Waste generation is of course a problem faced by most countries undergoing development, but the effect on SIDS is likely to be much stronger due to the small size territory size of these countries.

SIDS also face problems associated with their natural characteristics. They tend to have a unique and very fragile ecosystem. The uniqueness, which is an outcome of the insularity of SIDS, renders such islands as important contributors to global diversity (Dahl, 1991).

SIDS have a relatively large coastline in relation to the land-mass. Thus a relatively large proportion of land in such islands is exposed to sea-waves and winds, giving rise to a relatively high degree of erosion of beaches, cliffs and soil.

Many SIDS are also prone to natural disasters which impact heavily on the natural environment. Disaster vulnerability will be discussed separately below.

A major environmental problem associated with islands is global warming and sea level rise. Many SIDS, especially the low-lying coral atoll ones, are faced with the prospect of proportionately large land losses as a result of these changes. Again this issue will be discussed separately below.

In general SIDS tend to be less able to cope with environmental vulnerability due to their very limited resources. In many cases, expenditure related to the physical environment is not proportionately divisible according to population size, due to the relatively large overhead costs involved.

2.4 Social Vulnerability

According to Springer *et al* (2002) social vulnerability may be defined in terms of the extent to which the social structure of a community or a society is exposed to shock or stress brought about by economic strife, environmental changes, government policies or internal events and forces resulting from a combination of factors.

In his work on social vulnerability, St Bernard (2002) also focuses on factors generated internally, relating to education, health, resources allocation and communications. However, external factors also feature in the discussion, particularly with reference to the globalization process, and its impact on domestic employment.

ECLAC (2000a) highlights the increased precariousness of the job market as a major source of social vulnerability, with more temporary jobs offering insecure income, no contract and no social security. Other causes include the pullback of the State from some areas, changes in traditional social organization such as unions, and the difficulties facing small companies.

In some SIDS, problems of social cohesion exist due to ethnic or religious affiliation, which sometimes give rise to social conflicts, which in turn impact negatively on productivity and on sustainable development in general.

It can be argued that social vulnerability, as defined above, is likely to occur in most developing ones, but the impact on SIDS may be higher, given the high degree of economic vulnerability of SIDS, and given that relatively high population densities in such countries.

However, there are studies which would seem to indicate that social cohesion is stronger in SIDS than in larger territories. This argument is put forward by Streeten (1993), who also suggests that small states may be more flexible and resilient in the face of adverse events. Easterly and Kraay (2000) also express an optimistic note with regard to SIDS, stating that such states have, on average, higher productivity levels, lower infant mortality, higher educational attainment, and higher life expectancy, when compared to larger states.

This view is of course not shared by all authors. A Commonwealth Secretariat study concluded that small states have higher inequality than larger states and are more exposed to external shocks (Commonwealth Secretariat, 2000). This may be due to a widely dispersed populations in some small archipelagic island states, with a large percentage of income and employment occurring near the administrative centre.

2.5 Climate Change Vulnerability

The economic vulnerabilities just outlined limit the capacity of small island states to adapt to future climate change and sea-level rise.

The IPCC Third Assessment Report on Impacts, Adaptation and Vulnerability to Climate Change (IPCC, 2001: Chapter 17) concluded that "given their high vulnerability and low adaptive capacity to climate change, communities in small island states have legitimate concerns about their future on the basis of the past observational record and climate model projections". The Report identified the following key issues among the priority concerns of small island states:

- *Equity issues.* The small island states account for less than 1% of global greenhouse gas (GHG) emissions but are among the most vulnerable of all locations to the potential adverse effects of climate change and sea-level rise.
- *Sea-level rise.* Although there will be regional variations, it is projected that sea level will rise over the next 100 years as a result of global warming induced by emissions of green house gasses. This change in sea level will have serious consequences for the social and economic development of many small island states. For some islands, the most serious consideration will be whether they will have adequate potential to adapt to sea-level rise within their own national boundaries.
- *Beach and coastal changes.* Most coastal changes currently experienced in the small island states are attributable to human activity. With the projected increase in sea level over the next 50–100 years superimposed on further shoreline development, however, the coastal assets of these states will be further stressed. This added stress, in turn, will increase the vulnerability of coastal environments by reducing natural resilience, while increasing the economic and social "costs" of adaptation.
- *Biological systems.* Coral reefs, mangroves, and seagrass beds, which provide the economic foundation for many small islands, often rely on "stable" coastal environments to sustain themselves.
- *Biodiversity.* It is estimated that 33% of known threatened plants are island endemics, and 23% of bird species found on islands also are threatened. Although there is still some uncertainty about precisely how and to what extent biodiversity and wildlife in small islands will be affected, available projections suggest that climate change and sea-level rise will cause unfavorable shifts in biotic composition and adversely affect competition among some species.
- *Water resources, agriculture, and fisheries.* The availability of water resources and food remain critical concerns in island communities. Because water resources and agriculture are so climate sensitive, it is expected that these sectors also will be adversely affected by future climate and sea-level change. Although climate change is not expected to have a significant impact on world fisheries output, it is projected to have a severe impact on the abundance and distribution of reef fish population on the islands.
- *Human health, settlement and infrastructure, and tourism.* Several human systems are likely to

be affected by projected changes in climate and sea levels in many small island states.

- *Socio-cultural and traditional assets*. Sociocultural and traditional assets of many small island states, such as know-how and traditional knowledge, are under threat from climate change and sea-level rise.

2.6 Trade Vulnerability[1]

As already stated, SIDS tend to be heavily dependent on international trade. Several of them are facing major difficulties in their negotiations of accession to the WTO, both in terms of financial costs and liberalisation commitments. They are being urged to undertake the same level of obligations, and to make extensive liberalisation commitments, as large countries.

SIDS also tend to be heavily dependent on trade taxes and on trade preferences, so that adherence to the WTO rules is likely to create a higher degree of difficulty for these states when compared to larger ones.

The adoption of the WTO rules regarding subsidies are also likely to hit small states harder than larger ones, due to the fact that many SIDS rely on subsidies to counterbalance the relatively high per unit costs of manufacturing (mostly due to the problem of non-proportional divisibility of overhead costs and inability to reap the advantages of economies of scale).

Similarly, rules regarding state trading enterprises are likely to render many SIDS increasingly vulnerable due to their need to ensure regularity of strategic imports (notably fuel and food), which may require government intervention, at least as a last resort.

With regard to the TRIPS Agreement, the costs of adopting these Intellectual Property Rights standards, in terms of financial transfers from SIDS to developed countries through royalties and license fees, are estimated to be extremely high. The ability to derive advantage from the IPRs is severely limited by the lack of resources and the critical mass to undertake research and development in this regard.

Another trade issue relates to dispute settlement arrangement. SIDS tend to find it extremely expensive to bring cases and mounting a WTO defense in Geneva.

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[1] This section draws heavily on the contribution of Assad Bhuglah, Mauritius Ministry of Industry and International Trade to Witter, Briguglio and Bhuglah (2002).

2.7 Disaster Vulnerability

Many SIDS are located in the tropical zone, and are exposed to cyclones (hurricanes or typhoons), tsunamis and coastal floods. A number of SIDS are of volcanic origin and experience volcanic eruptions and earthquakes, some with devastating effects.

Although natural disasters occur all types of countries, the impact of a natural disaster on an island economy is expected to be relatively larger in terms of damage per unit of area and costs per capita, due to the small size of the country's territory and relatively high population density. In some instances natural disasters threaten the very survival of some small islands, through, for example, the devastation of the agricultural sector, the wiping out of entire village settlements, the disruption of a high proportion of communication services and injury or death of a relatively high percentage of inhabitants.

The Programme of Action for the Sustainable Development of Small Islands States, when referring to natural disasters (United Nations, 1994: paragraph 20) listed a number of factors that should be considered when assessing exposure to natural hazards. These include:

- The extent to which a country has established disaster preparedness and management institutions and policies (such as building codes, regulatory and enforcement systems) in order to mitigate, prepare for and respond to natural and environmental disasters;
- The extent to which a country has developed early warning systems and facilities for the rapid dissemination of information and warnings;
- The extent to which local broadcasting can be accessed to assist remote rural and outer island communities within countries and among neighbouring countries during disaster events;
- The degree of funding (including insurance) for communities hit with natural disasters;
- The degree to which natural and environmental disaster policies are integrated into national development planning processes;
- The degree to which cultural and traditional systems improve the resilience of local communities to disaster events.

2.8 Vulnerability and Resilience

When discussing vulnerability, the issue of resilience often crops up. This term refers to the ability of an affected subject to recover quickly from a damaging impact. Resilience, as defined here, is also associated with the coping ability of the affected subject, with regard to the damaging impact. In climate change language it may be associated also with adaptation.

Resilience may be inherent or nurtured. The inherent aspect of resilience may be considered as the

obverse of vulnerability, in the sense that inherently resilient countries should register low inherent vulnerability scores.

Nurtured resilience, namely that which is developed and managed, often as a result of some deliberate policy, should not be confused with inherent vulnerability (or its obverse inherent resilience). Again here we refer to the "Singapore Paradox" where an inherently economically vulnerable small state has managed to cope with this vulnerability through deliberate economic development policies. In this case the "ability to cope" was nurtured.

Recently, there has been considerable debate on the issue of building resilience in SIDS.[2] This issue is important because it carries the message that SIDS should not be complacent, even if inherently vulnerable. In other words they should adopt measures to step up economic, environmental and social resilience.

In addition the discussion on resilience sheds light as to why a number of vulnerable SIDS have managed to do economically do well in spite (and not because) of their economic vulnerability.

2.9 Internal and External Factors

An important consideration with regard to vulnerability is that while in the case of economic, environmental, climate change and disaster vulnerability the thrust of the argument relates to damage caused by external forces, and not the result of domestic polices, in the case of social vulnerability, there seems to be more emphasis on internal factors. This consideration also touches upon the issue of resilience. If the factors affecting social vulnerability are internally generated, the question may be related more to nurtured 'social' resilience (or lack of it) than to vulnerability itself. Thus alleviation of poverty could improve levels of education and sanitation, quality of dwellings, and reduction of crime, all of which would enhance the resilience of society to economic and environmental vulnerability. This issue will be discussed further below.

3. THE VULNERABILITY INDEX

3.1 Origins and Developments

The concept of the vulnerability index was developed by the present author during the second half of the eighties as it was felt that it was desirable to measure economic vulnerability of countries, given

[2] See for example, Witter, Briguglio and Bhuglah (2002) and University of the West Indies (2002).

that many small island states, including Malta, were registering relatively high GDP per capita scores, concealing their inherent economic fragility.

Within the UN system, the construction of the index was first formally proposed by Malta on 26 June 1990, during the meeting of Government Experts of Island Developing Countries and Donor Countries and Organisations, held under the auspices of UNCTAD.[3] When the General Assembly, at its 47th session, resolved to convene this SIDS Global Conference (A/Res/47/189 of 10 March 1993), which was subsequently held in Barbados in April 1994, the vulnerability index featured prominently in the preparatory meetings and in Global Conference for the Sustainable Development of Small Island Developing States held in Mauritius in 1994. The Programme of Action which was approved in this conference, and endorsed by the General Assembly in 1994 in its resolution 49/122 of 19 December 1994, stated in Paragraphs 113:

> "Small Island developing States, in cooperation with national, regional and international organizations and research centres, should continue work on the development of vulnerability indices and other indicators that reflect the status of Small Island Developing States and integrate ecological fragility and economic vulnerability. Consideration should be given to how such an index, as well as relevant studies undertaken on small island developing States by other international institutions, might be used in addition to other statistical measures as quantitative indicators of fragility."

The first peer reviewed paper on the Vulnerability Index was published by the present author in *World Development* of September 1995 (Briguglio, 1995). Subsequently, the Commonwealth Secretariat and individual researchers, notably Tom Crowards, produced their own versions of the economic vulnerability index.

During the late nineties, an Environmental Vulnerability Index also started to be developed by SOPAC. At present there are attempts to develop a Social Vulnerability Index.

In what follows, we shall concentrate on the Economic, Environmental and Social Vulnerability Indices, which were developed with an interest SIDS. Although many other vulnerability indices were developed (see Kaly *et al*, 2003) these will not be reviewed in this paper.

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[3] In his speech, the Maltese Ambassador suggested that a vulnerability index be constructed, stating, *inter alia*, that such an index "is important because it reiterates that the per capita GDP of Island Developing Countries is not by itself an adequate measurement of the level of development of island developing countries as it does not reflect the structural and institutional weaknesses and the several handicaps facing Island Developing Countries." Subsequently UNCTAD engaged Lino Briguglio to prepare a paper on the construction of a vulnerability index which was one of the main documents discussed during a meeting of a Group of Experts on Island Developing Countries, held in Geneva on 14-15 July 1992.

3.2 The Economic Vulnerability Index (EcVI)

The economic vulnerability indices that were proposed by different authors (Briguglio, 1995; Chander, 1996; Wells, 1997; Crowards, 1999; Atkins *et* al 2000; UN-CDP, 2000) were generally composite ones with very few components[4], derived from data often available in published statistical reviews[5] and this is probably the reason why it was found possible to construct such indices with a relative degree of ease. One version of the index, namely that constructed by the UN-CDP, is operational and is used as one of the indices to determine whether a country is to graduate out of the Least Developed Countries group.

The principal variables which have been used as components of the Vulnerability Index in the context of SIDS relate to inherent conditions which render them exposed to external factors, and include economic openness, dependence on a narrow range of exports, peripherality, and dependence on strategic imports.[6] The Economic Vulnerability Indices so far produced indicate clearly that small island developing states, as a group, tend to be more economically vulnerable than other countries.

Economic openness

Economic openness captures the degree to which a state is susceptible to economic conditions in the rest of the world. It is often measured by expressing exports or imports, or an average of both, as a percentage of GDP.[7]

Dependence on a narrow range of exports

The range of exports categories captures the extent to which a country is diversified in terms of its dependence on the rest of the world. This exacerbates the problems associated with high dependence on international trade. The variable is usually measured by the export concentration index devised by UNCTAD, which only covers merchandise. Briguglio (1997) argued that export concentration can also be observed in the trade in services, especially in tourism and financial services, and he devised a

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[4] Generally the components of the economic vulnerability index did not exceed 5.
[5] Such at the IMF's *International Financial Statistics* and UNCTAD's *Handbook of International Trade and Development Statistics*.
[6] The UN-CDP does not contain an economic openness component. This index will be discussed separately below.
[7] During the December 1997 UN meeting on the Vulnerability Index, some participants contended that this variable should not form part of the vulnerability index because high dependence on foreign trade is not a disadvantage but strength of SIDS. As a result, the Committee for Development Policy (UN-CDP) excluded this variable from its Economic Vulnerability Index. In response to this contention, it can be argued that the vulnerability index should capture the degree of exposure to external factors, and therefore an index of openness is important in this regard. The UN-CDP included, as one of the index components, a size variable, which may indirectly be capturing the degree of openness, given that economic openness and country size are very closely correlated.

concentration index with exports of services included (see also Briguglio and Galea; 2003).

Dependence on strategic imports

The "dependence on strategic imports" variable is intended to measure the extent to which a country's livelihood depends on imports. There are obvious vulnerability connotations, when a country depends heavily on imported energy and industrial supplies for production and on imported food for consumption. Various indices have been used for this purpose. Briguglio (1997) and *Atkins et al* (2000) suggested that this variable can be measured as average imports of commercial energy as a percentage of domestic energy production. Briguglio and Galea (2003) also used dependence on food imports in this regard.

Peripherality

Peripherality is associated with insularity and remoteness, leading to high transport costs and marginalization. Again, this exacerbates the problems associated with high dependence on international trade. The measurement of this variable poses some difficulty. If measured directly by taking the number of kilometres from a main commercial centre, the nearest island or the nearest continent, the information could be misleading. In the case of certain islands, a relatively large proportion of international trade is directed to and from their former colonizing powers, even though other centres of commercial activity could be more proximate. Two variables which may reflect peripherality are (1) the ratio of FOB/CIF factors and (2) the ratio of transport and freight costs to international trade in merchandise. The second has been considered to be more meaningful in studies that utilise the "paripherality" variable.[8]

Economic vulnerability and economic resilience

An important consideration relating to the economic vulnerability index relates to resilience. Briguglio and Galea (2003) constructed an index, which incorporates an economic resilience component, calling it EVIAR (Economic Vulnerability Index Adjusted for Resilience). They argued that a simple indicator of resilience is GDP per capita[9], because this variable captures a country's material ability to cope with vulnerability.[10] Briguglio and Galea assigned a weight of 50% to the vulnerability components and

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[8] See Chander (1996), Crowards (1999) and Briguglio (1995).

[9] The Commonwealth Secretariat used GDP (and not GDP per capita) as a resilient component, assuming that the larger the GDP the better is the ability to cope. The problem with using GDP as against GDP per capita is that the results will be biased in favour of small states, leading to the conclusion that small states are less resilient by assumption – thereby *a priori* assuming what is to be tested.

[10] An attraction of GDP per capita is that it is readily available, and can be adjusted for purchasing power standard.

50% to the resilience component.[11] The EVIAR may help explain the "Singapore Paradox" already referred to above, in the sense that we can have inherently vulnerable countries which, mostly though suitable policies, have succeeded in strengthening their economic resilience, and overcoming their vulnerability.

The CDP Economic Vulnerability Index

The Committee for Development Policy (CDP) of the UN ECOSOC developed a vulnerability index which it uses for the purpose of identifying the Least Developed Countries (UN-CDP, 2000):
Share of Manufacturing and Modern Services in GDP
Merchandise export Concentration

- Instability of Agricultural Production
- Instability of Exports of goods and services
- Population size

As stated, the CDP uses this index as one and is used as one of the indices to determine whether a country is to graduate out of the Least Developed Countries group.

The CDP Vulnerability Index assigns importance to instability, which implies that countries with relatively higher unstable export growth or agriculture production are to be assigned higher vulnerability scores.

The "population size" component of the index is intended to capture structural constraints, in responding to external shocks. This component is very problematic if the index is to be used in the context of SIDS, since it will bias the index in favour of small states, thereby begging the question. It would therefore not be proper to use this sub-index to show that small states are more vulnerable than larger ones.

3.3 The Environmental Vulnerability Index (EVI)

An environmental vulnerability index (EVI) is being developed by the SOPAC (Kaly *et al,* 1999a; 1999b; 2003). The study attempts to develop a methodology for calculating the index and to identify and collect data to calculate the index. The SOPAC EVI is not intended to measure vulnerability with regard to humans, and its focus is on the potential for damage to the natural environment *per se,* irrespective of whether or not there are human settlements within that environment. Kaly *et al* (2003)

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[11] In Briguglio (1995) adopted a similar procedure to allow for resilience, calling the index combined index Vulnerability Adjusted Development Index (VADI).

justify this focus on the grounds that it is the natural environment that is the foundation for the economic and social structures of nations.

A total of 54 sub-indices (components) of environmental vulnerability were selected for inclusion in the index (Kaly *et al,* 2003). Many of the sub-indices were expressed as a ratio of area of land or coast rather than simply absolute numbers because it is risk density or proportion of area degraded that is of interest from an environmental perspective.

The EVI contains three aspects of vulnerability, namely (a) natural and anthropogenic risks to the environment, with 27 sub-indices (b) intrinsic resilience with 8 sub-indices ; and (c) extrinsic resilience, with 19 sub-indices. Intrinsic resilience refers the innate ability of the environment to cope with hazards (expressed as good recovery rates, high productivity or natural resistance to damage) and extrinsic resilience refers to ecosystem health (the amount of degradation of the environment as a result of past impacts determines the ability of ecosystems to cope with future stresses).

Due to the fact that the index is composed of a large number of 54 sub-indices, many of which are not published in any international statistical review, progress with the EVI has been slow and currently the index cannot be said to be operational. In fact, although SOPAC published what it called a "demonstration EVI" for 235 countries, this can be considered as "work in progress" given that data were unavailable for 13 of the 54 indicators for all countries, so that none of the countries attained the condition of the EVI that at least 80% of the indicators must be evaluated for a valid EVI score (see Kaly et al. 1999b).[12] The results of the "demonstration EVI" do not exhibit a clear cut tendency that SIDS are in general more environmentally vulnerable than larger territories, although, as stated, data deficiencies do not permit definite conclusions in this regard.

3.4 The Social Vulnerability Index (SVI)

The computation of a social vulnerability index is still at a rudimentary stage. The main initiative in this regard has been taken by UN-ECLAC, and representatives of this organization have proposed the construction of such an index for the Caribbean region (ECLAC, 2002b; ECLAC, 2003) .[13] As far as is

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[12] SOPAC has however indicated that it is working on finalising it in time for the August Mauritius meeting on the BPoA+10 (see Kaly *et al,* 2003).

[13] A call for the creation of such an index has been made in the Singapore declaration of the Alliance of Small Island States during the Inter-regional preparatory meeting for the World Summit on Sustainable Development held in Singapore from 7 to 11 January 2002.

known by the present author, a global social vulnerability index to compare vulnerability scores across countries has not so far been produced.

The ECLAC model, which is associated with the work of Godfrey St Bernard (see St Bernard, 2000) attempts to measure social risk and social resilience through variables, relating to (i) education, with three indicators respectively measuring exposure to secondary and tertiary education level and adult literacy; (ii) health, with one indicator, measuring life expectancy at birth, (iii) security and social order, with one indicator, measuring indictable crimes per 100,000 population; (iv) resources allocation, with four indicators, measuring poverty and relating poverty to lack of primary education, lack medical insurance, and unemployment; and (v) communications architecture, with one indicator relating to computer literacy. The SVI, as proposed by ECLAC is therefore a composite one, with 10 components. So far, however, the actual computation of the index has not been undertaken, principally because paucity of data.

In the case of the SVI, there are a number of conceptual issues that have yet to be resolved. These include:

(a) Should the index be concerned with poverty and factors that lead to poverty? In this case the term "poverty index" would seem to be more appropriate than "vulnerability index.[14]

(b) Should the index be concerned only or mostly with internal forces or with damage caused by exposure to external factors, such as the globalization process? If the focus is to be on external forces, conditions resulting from bad internal management and inadequate governance should be excluded or downplayed, given that these are not the result of such exposure.

(c) Should the index be based on the argument that once it is proven that SIDS are more economically and environmentally vulnerable than larger territories, than it follows that SIDS are also more socially vulnerable? In this case, the development of a separate social vulnerability index might not be needed.

The present author is of the opinion[15] that one approach to tackle these issues is to call the index a Social Resilience Index (SRI), on the assumption that countries that are economically and/or environmentally vulnerable due to their exposure to damage from external factors, will be less able to cope or bounce back if they are socially fragile – or conversely better able to cope if they are socially resilient.

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[14] It would seem that work on the conceptual framework on this index use the term vulnerability to refer to the so-called "vulnerable groups" that are exposed to poverty.

[15] This opinion was expressed formally in an intervention during the "Ad Hoc Expert Group Meeting on a Methodological approach for a Social Vulnerability Index for Small Island Developing States", organized by ECLAC in Port of Spain in July 2003.

4. METHODOLOGICAL CONSIDERATIONS

Various methods have been used for the construction of the vulnerability index. The basic difference relate to the summation of the components of the index. There are three main methods, namely (a) the normalization procedure (b) mapping along a numerical scale and (c) regression method.

4.1 Normalization Procedure

The components of the vulnerability index are often measured in different units, and therefore straight-forward summation would not be valid. However the observations can be 'standardized' or 'normalized' to permit additive or multiplicative averaging, with the average being called a composite index.

A normalization procedure commonly used is that which adjusts the observation to take a value of between 0 and 1, using the formula:

$$Vij = (Xij - MinXi) / (MaxXi - MinXi)$$

where:

- Vij stands for the standardized vulnerability score with regard to vulnerability component i, for country j;
- Xij stands for the observed value of the same component for the same country;
- MaxXi and MinXi stand for the maximum and minimum value of the observed range of values of the same component, for all countries in the index.

Vij will therefore take a value of between 0 and 1. If Xij (the observed value) is the minimum in the range of values, Vij would be zero. If Xij is the maximum in the range Vij would take a value of 1. This method was also used by Briguglio (1992; 1993; 1995; 1997), Chander (1996) and Crowads (1997).

All the components of the index can then be summed on the basis of equal or varying weights assigned to each component. Briguglio (1995) and Crowards (1997) experimented with varying weights for each component in their computation of the Vulnerability Index, but their preferred method was that involving equal weights.

The most important shortcoming of this method is that the weights for averaging the components of vulnerability are arbitrarily chosen, and that the distribution of the normalized variables are heavily

influenced by outlier observations.

4.2. Scoring on a Multi-Point Mapping Scale

This method essentially involves categorising an occurrence (in terms of intensity or frequency) along a scale of say 1 to 7 with 1 being the lowest possible occurrence and 7 the highest possible. For example, in the case of floods, 1 will be assigned to absence of floods and 7 to the highest possible occurrence in the geographical areas considered. The number 4 would then represent some sort of middle value. The wider the spread of the scale, the more possible will it be to derive meaningful standard deviations of the averages obtained, but there is a limit to how many meaningful categories one can work with. The following is an example of a 7 point mapping scale:

1	2	3	4	5	6	7
Absent	Very rare	Rare	Average frequency	Moderately higher than average frequency	Markedly higher than average frequency	Highest possible frequency

This approach is very useful when data is qualitative, and when the researcher desires to transform it into a quantitative format. It also permits non-linearity, such as for example, in cases where the occurrence grows or declines exponentially or when it takes a U-shaped or S-shaped pattern. This approach was used by Kaly *et al* in the construction of the Environmental Vulnerability Index.

4.3 The Regression Method

The regression method was used by Atkins *et al* (2000) and Wells (1997). The basic assumption is that a dependent variable can be found as a proxy for vulnerability (Atkins et al and Wells assumed that GDP volatility is a suitable proxy in this regard) and this is regressed on a number of explanatory variables which represent vulnerability index components. This method lets the data produce the weights and does not require 'normalization' of the observations.[16] The coefficients on the explanatory variables of the estimated equation are taken as weights for averaging the components of the index.[17]

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[16] A regression method was also used by Dao and Pedruzzi (2003) to predict the extent to which risk is determined by the probability of hazards and the vulnerability of the exposed community.

[17] The method involves estimating an equation of the type: V = a (V1) + b (V2) + c (V3)
where V1, V2 and V3 represent the individual components of the index; a, b and c are estimated coefficients using the least squares method; and V is the predicted dependent variable, which is then used as an index. The estimated coefficients are taken as the weights for summing the components.

However this approach has a number of methodological defects, which limit the operationality and the reliability of the index. The most important methodological defect is that if the dependent variable is considered to be a proxy for the variable to be indexed, one need not go through a cumbersome regression procedure to compute the index.

5. OPERATIONALITY AND "POLITICAL" CONSIDERATIONS

This section will cover two aspects associated with the operationality of the vulnerability index, namely its desirable attributes and data gathering problems.

5.1 Desirable Attributes

The operationality of and the support for the Vulnerability Index would be enhanced if it satisfies certain criteria, notably simplicity and ease of comprehension, affordability, suitability for international and temporal comparisons and transparency.

Simplicity

The present author has on many occasions (e.g. Briguglio 1992, 1995, 1987) insisted on simplicity as one of the most important desirable attributes of an indicator. One of the advantages of simplicity is ease of comprehension by decision-takers and other users of the index. This criterion implies also that the overall composite index must have an intuitive meaning, that it clearly captures the facets of the individual variables that it purports to represent. It also implies that it can be easily replicated by third parties for evaluation and verification.

Affordability

Affordability is related to the "simplicity" criterion. Data must be relatively easy to obtain and to process. Preferably it should be collected as a matter of routine in line with the information required for the management of a country. The index should be procurable at reasonable cost, money and time-wise. This desirable attribute is often overlooked in academic discussion, although when it comes to actually computing the index, researchers soon realize that cost is perhaps one of the most important constraints.

Suitability for international and temporal comparisons

The index of the type we are discussing in this paper (i.e. developed for the purpose of comparing

scores across countries) should lend itself to international comparisons and comparisons over time. Hence it must be based on variables which are measured in a homogenous manner internationally and temporally.

Transparency

The index should be verifiable and reproducible by persons other than the original producer of that indicator. This will be essential for validation, evaluation and quality control purposes. This of course requires that the raw data should be made available to the evaluators. This also requires that the methodology used should be clearly explained by those constructing the index, in a manner which could be easily understood by the users of the index and its evaluators.

5.2 Data Gathering Process

Data gathering is usually the hardest nut to crack when it comes to constructing indices. The most important problems are generally associated with (a) lack or shortage of data (b) non-homogenous definitions across countries (c) unwillingness by the proprietors of the data to make this data available to third parties; and (d) deliberate misrepresentations to advance the interests of the country concerned, or of its government.

Lack or shortage or other inadequacies of data

At times, data on certain events is not gathered, or its coverage is limited in terms of time and space. In this case the researcher might have to resort to questionnaires or some forms of collecting original data. In some cases, proxy variable may be suitable for the task at hand.

Non-homogenous data

Often, data gathering on a particular component of an index is made by different people in different locations. In the case of economic variables, there are major institutions, like the IMF and the World Bank which take steps to audit the data and render them comparable across countries – unfortunately such institutions are generally lacking in the environmental and social fields. To ensure that the variables are homogenously defined across countries, especially when different data collectors are involved, each index component of the index should be accompanied by a detailed explanation of what the component is attempting to measure. In this regard data sheets to provide guidance for the data provider and data collector would be very useful to reduce discrepancies.

Unwillingness to provide data

Sometimes certain government departments or agencies are reluctant to share data with other government departments, let alone with independent researchers. Some of the components of the indices may require information that could only be provided by the authorities in the respective country. This means that, in such cases, government co-operation in the data gathering process is essential. The solution here could be to garner support from the central statistical agency, which is often statutory empowered to impose transmission of data from different government departments and agencies.

Deliberate misrepresentations

A pernicious data problem relates to deliberate misinformation. There may be interests in exaggerating vulnerability scores to elicit funds, or downplaying it to enhance the international prestige of the government concerned. It is therefore very important to have some auditing procedures to check for this possibility.

6. STRENGTHS AND WEAKNESSES OF INDICES

6.1 Benefits

The Vulnerability Index has a number of functions and benefits. It can be used to support decision-making and can be useful for setting targets and establish standards, to monitor and evaluate developments and to provide quantitative estimates. It can help to disseminate information and to focus the discussion given that quantification requires pre-definition. Given that the vulnerability index is a composite one, it can promote the idea of integrated action and to draw attention of the issue being investigated.

Supporting decision-making, setting targets and establishing standards

Decision-making by the government and other authorities should lead to action which is systematic and coherent and based on transparent information. The vulnerability index may also be used to set the direction of action and to justify certain priorities. The index could also be useful for setting targets. For example, a country with high vulnerability scores in certain economic areas, may set targets to step up its resilience with regard to the economic variable.

Monitoring and evaluating developments

Indices are of utmost important to assess whether a given policy or decision is yielding the desired results and to assess whether changes of direction are needed. In this way, decisions are not taken blindly or based only on haunches and feelings, but will be based on scientific information presented in index format.

Deriving quantitative estimates

An index summarises complex phenomena, often yielding a single-value measure of the phenomena under consideration. This is useful, if not essential, for donor countries and organizations when taking decisions regarding the allocation of financial and technical assistance, or for assigning special status to vulnerable countries.

Dissemination of information and drawing attention to the issue

The vulnerability index can be used to make the public more aware of certain problems, and to give high profiles to certain trends which can strengthen resilience. In this regard, indices can be used for communication and for alerting stakeholders about issues, including dangers, failures and success stories.

An index is a very good instrument for drawing attention to the issue being investigated. Thus for example, the exercise of computing an index on environmental or social vulnerability may itself make decision makers aware of the gravity of these problems. Such an exercise may also generate academic discussion and enhance awareness amongst scholars on the issues involved.

Focusing the discussion

Indices can help to develop a common language for discussion. One often one finds that persons engaged in debate go off at tangents because of lack of common definitions. In the case of indices the quantification of its components requires precise definitions, and this could help focus the discussion on matters directly relevant to the issue.

Promoting the idea of integrated action

It is often counterproductive to take action in one area in isolation from others. The vulnerability indices, as developed so far, are composite indices. This could help to foster an awareness of the interconnections between the different aspects of vulnerability and therefore promote the idea of integrated action.

6.2 Weaknesses of Indices

Indices share a number of weaknesses, principally associated with the subjectivity in their computation, in particular with regard to the choice of variables, the method of measurement and the averaging procedure.

Subjective choice of variables

The question of subjective choice of variables is difficult to resolve. This is, however, not a problem peculiar to the vulnerability indices but to most empirical work, especially in the case of multivariate analysis.

This problem can be minimised if the objective of the index is clearly spelled out. In the case of the vulnerability index, the present author has on many occasions (e.g. Briguglio 1995; 1997) attempted to delimit the objective of the index so as to (a) avoid using variables which reflect poverty, given that the objective is to measure vulnerability and not poverty; (b) include only those variables which are related to inherent conditions, and not to self-inflicted problems; and (c) choose variables which reflect proneness to damage from external forces.

Problems of measurement

The measurement problems arise in part because of an absence of data for certain variables or for certain countries; different methods of statistical compilation across countries; and errors in measurements of the variables. These problems have already been discussed above with regard to data gathering.

Averaging and weighting procedure

Composite indices are averages of different sub-indices, and the single value which they produce may conceal divergences between the individual components or sub-indices, possibly hiding useful information. Furthermore, a composite index implies some form of trade-off between the sub-indices of the composite index and averaging would conceal, for example, situations where the effect of one variable cancels out the effect of another.

In addition there is the problem of whether to take a simple average or a weighted average and, in the latter case, which weights are to be assigned to the different variables. In general, the weighting problem remains in the realm of subjectivity, with the simple average having a favourable edge on

grounds of simplicity.

Aggregation problems

An issue that often emerges in discussions on vulnerability indices relates to the level at which indices should be aggregated: national or regional.[18] The Economic Vulnerability Index and the Environmental Vulnerability Index are pitched at the national level, thereby comparing large countries like China, the Russian Federation and the United States of America, with very small islands states. To some this would seem to be a meaningless comparison. For example, in each large nation one is bound to find vulnerable and non-vulnerable regions, so that when aggregating, the average would not really represent the conditions in the individual regions. However, given that these indices are required to make a case that certain countries or group of countries are more vulnerable than others, country comparisons cannot be avoided.

One possible solution is to work out vulnerability indices at the regional level, so as to provide some sort of standard deviation from the national average. However there are two pitfalls in this regard. The first is that data is often difficult to obtain at the regional level. The second is that even regions have sub-regions with different vulnerabilities, which again have different sub-sub regions, and if this argument is taken to its absurd conclusion, it would be difficult to decide when to stop the disaggregation process.

Political aspects

As stated Vulnerability Indices are generally pitched at the national level. This may create problems of a "political" nature, in that the results could pit nations against each other. This problem may lead to lack of political support from certain countries who do not receive high vulnerability scores on the index.

7. CONCLUSION

This paper dealt with conceptual and methodological aspects associated with vulnerability and its measurement, with special reference to SIDS.

As stated, the Economic Vulnerability Indices produced so far indicate clearly that SIDS tend to be more economically vulnerable than other groups of countries. In the case of the economic and social vulnerability indices, work is still at an early stage of development and there is no conclusive

[18] The term "regional" as used here refers to a sub-division of the "national".

quantitative evidence as to which type of countries are particularly vulnerable.

The paper also discussed a number of methodological issues related to the vulnerability index and discussed the strengths and weakness of the index. It was argued that a number of criteria need to be observed when constructing the index, to elicit support for it and to render it operational.

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